



US009410877B2

(12) **United States Patent**
Maxey et al.

(10) **Patent No.:** **US 9,410,877 B2**
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **DETERMINING WELLBORE FLUID PROPERTIES**

(71) Applicant: **Halliburton Energy Services, Inc.**,
Houston, TX (US)
(72) Inventors: **Jason Eric Maxey**, Spring, TX (US);
Xiangnan Ye, Cypress, TX (US);
HsinChen Chung, Houston, TX (US);
Narongsak Tonmukayakul, Spring, TX (US)

(73) Assignee: **Halliburton Energy Services, Inc.**,
Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 739 days.

(21) Appl. No.: **13/650,943**

(22) Filed: **Oct. 12, 2012**

(65) **Prior Publication Data**

US 2014/0105446 A1 Apr. 17, 2014

(51) **Int. Cl.**

G01N 11/04 (2006.01)
G01N 11/06 (2006.01)
E21B 49/08 (2006.01)
G01N 33/28 (2006.01)
G01N 11/00 (2006.01)
G01N 9/32 (2006.01)

(52) **U.S. Cl.**

CPC **G01N 11/04** (2013.01); **E21B 49/08** (2013.01); **G01N 33/2823** (2013.01); **G01N 9/32** (2013.01); **G01N 11/06** (2013.01); **G01N 2011/0026** (2013.01); **G01N 2291/02818** (2013.01); **G06T 2207/30108** (2013.01)

(58) **Field of Classification Search**

CPC **G01N 11/06**; **G01N 11/04**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,699,804 A * 10/1972 Gassmann et al. 73/54.07
4,302,965 A * 12/1981 Johnson et al. 73/54.07
4,828,034 A * 5/1989 Constien et al. 166/308.4
5,327,778 A * 7/1994 Park 73/54.21
5,414,778 A * 5/1995 Schwartz et al. 382/142

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO 2013005185 A1 * 1/2013

OTHER PUBLICATIONS

Mobile Phone Enabled Pervasive Measurement of Liquid Viscosity by Yang Yang et al, pp. 1-5 2011.*

(Continued)

Primary Examiner — Akash Saxena

(74) Attorney, Agent, or Firm — Craig Roddy; Fish & Richardson P.C.

(57)

ABSTRACT

Computer-implemented methods, software, and systems for determining a property of a wellbore fluid are disclosed. In some implementations, a computing system receives an image of a first sample of the wellbore fluid filling a conduit to a threshold volume of the conduit. The computing system determines a first time duration of the first sample of the wellbore fluid filling the conduit to the threshold volume of the conduit based on the image of the first sample. The computing system receives an image of a second sample of the wellbore fluid filling the conduit to the threshold volume of the conduit. The computing system determines a second time duration of the second sample of the wellbore fluid filling the conduit to the threshold volume of the conduit based on the image of the second sample. A property of the wellbore fluid is determined based on a difference between the first and second time durations.

11 Claims, 11 Drawing Sheets

